self-contained device (Heart Aid, Cardiac Resuscitator Corporation, Wilsonville, Oregon) that automatically identifies ventricular fibrillation and applies countershocks is now commercially available. This automatic defibrillator requires very little training to use and costs about as much as a standard monitor-defibrillator. Electrodes are applied to the tongue and epigastrium, the machine is activated and cardiopulmonary resuscitation interrupted for a maximum of 15 seconds. The device then analyzes the electrocardiographic findings and checks for spontaneous respirations (via a breath sensor in the mouth). Countershocks are delivered when appropriate and results analyzed. Prerecorded voice messages prompt emergency medical services personnel to assist respirations, check for pulses, continue cardiopulmonary resuscitation and so forth. Rozkovec and co-workers showed the safety and efficacy of the tongue-epigastric route for cardioversion, delivering charges of up to 320 J. Jaggarao and colleagues treated 11 consecutive patients in cardiac arrest with the automatic defibrillator: six were successfully defibrillated and resuscitated and five were discharged alive from hospital. The device also has an automatic external pacing function that has not been as extensively studied. Clinical trials are ongoing in many states, and results continue to support the addition of the automatic external defibrillator as a valuable tool for emergency medical services personnel.

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Aeromedical Emergency Care

ROTORCRAFT AEROMEDICAL emergency care was born during the closing days of World War II when the early Sikorsky helicopters were used to evacuate casualties in the European theater. The extensive use of rotorcraft for this purpose did not take place until the Korean conflict, during which time both the Army and Air Force used Bell 47s to evacuate casualties to Mobile Army Surgical Hospital (MASH) units. This expertise was extended to the civilian sector following the close of the Korean conflict in the form of dual-purpose public safety services in which rotorcraft was used for both public safety missions, such as law enforcement and fire suppression, and emergency medical service missions. Due to the dual service nature, the medical expertise of the flight crews was very limited. In the early 1970s, rotorcraft began to be based at hospitals and fully committed to emergency medical service missions. Because a rotorcraft was stationed at a hospital, the medical flight crews could be selected from the more experienced medical personnel within the institution. Flight nurses became the mainstay of these services and brought a level of medical expertise to the field heretofore unseen. At that time, paramedics could place peripheral intravenous lines, administer a limited number of drugs and use the defibrillator/cardioverter. Flight nurses, on the other hand, were trained to place endotracheal tubes, thoracostomy tubes, central intravenous lines, administer a wide spectrum of drugs and do all those procedures paramedics could do. In 1976 physicians were placed on hospital-based rotorcraft emergency care services and the potential for bringing even a higher level of expertise to the field became limited only by the training of a physician. The capability to do cricothyroidotomy, pericardiocentesis, place cranial trephines and even perform open thoracotomies in the field became a reality.

Recently, the impact of these services on mortality from blunt trauma has been investigated in two studies. In the first, the mortality of 150 consecutive trauma patients treated at the site of injury and transported to a trauma center by standard land prehospital care services was compared with that of 150 consecutive trauma patients treated at the site of injury and transported to the same trauma center by a rotorcraft aeromedical service staffed by a physician and nurse. A statistical analysis designed to predict mortality based on injury severity showed that the mortality of the land group was statistically no different from that of a large index trauma patient population treated at a major trauma center. There was a 52% reduction in predicted mortality of the aeromedical group, which was statistically significant ($P < .001$).

In the second study the same methodology was used; the mortality of 1,273 patients treated and transported by seven different hospital-based rotorcraft aeromedical services was compared with that of more than 3,000 patients treated by land emergency medical services and transported to 45 trauma centers across the United States. This study showed a 21% reduction in the predicted mortality, which was also statistically significant ($P < .001$).

In both studies the patients treated by the aeromedical services were more seriously injured than those treated by the control services. In addition, of those patients who died, death was caused by more severe injuries in the aeromedical group; of those patients who survived, survival was despite more serious injuries in the aeromedical group. The major reduction in predicted mortality was in those aeromedical patients who had suffered more severe injuries, representing less than 20% of all trauma patients treated by these services.

In conclusion, it appears that hospital-based aeromedical emergency care services may reduce mortality of at least blunt trauma patients, and that the most seriously injured patients seem to receive the greatest benefit from these services.

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Calcium Channel Blockers in Emergency Medicine

OVER THE PAST few years a new class of drugs, the calcium channel blockers, has been introduced. As a group, these drugs inhibit the intracellular movement of extracellular calcium through voltage-dependent membrane channels. Because cardiac and vascular smooth muscle is particularly

dependent on calcium for its function, it is not surprising that calcium channel blockers have specific value in the treatment of cardiovascular disease. The calcium channel blockers most recently released in the United States for commercial use are nifedipine and diltiazem hydrochloride.

At the recommended dosage, nifedipine, unlike verapamil hydrochloride, has no effect on the sinoatrial or atrioventricular node. In addition, it does not significantly depress myocardial contractility. It can, therefore, be used safely in patients with conduction abnormalities and congestive heart failure. Its major target tissue is vascular smooth muscle. Of the calcium channel blockers currently available, nifedipine is the most potent vasodilator. Its use in the emergency room is dependent on this effect. Nifedipine produces coronary artery dilation, rendering it very effective for treating vasospastic (Prinzmetal's) angina. Given sublingually, it is simple to administer and acts rapidly. Nifedipine also induces systemic vasodilation and is emerging as an effective drug for control of cases of hypertension in the emergency room. Unlike other calcium channel blockers, tachyphylaxis to its antihypertensive action has not been reported. For patients with diastolic pressures lower than 110 mm of mercury, 10 mg given sublingually or orally usually achieves good control. For diastolic pressures greater than 110 mm of mercury, 20 mg is given. An additional 10-mg tablet can be given after one hour if necessary. A mild increase in heart rate of approximately ten beats per minute may result.

Long-term use of nifedipine does not produce sodium retention, plasma volume expansion or renin release. Combining it with propranolol hydrochloride provides additional antihypertensive control, blocks the reflex increase in heart rate and permits twice-a-day dosage of nifedipine. Methyldopa can also be used but the nifedipine must be given every six hours. Mild pedal edema can be managed with the use of diuretics. Because vasodilation with subsequent afterload reduction decreases myocardial oxygen consumption, nifedipine is also effective in treating classical angina; it is infrequently used in emergency departments for this indication, however, because of the efficacy of nitroglycerin.

Diltiazem is the latest calcium channel blocker to be released. Its actions are intermediate to those of verapamil and nifedipine. Diltiazem is equivalent to verapamil in depressing atrioventricular node conduction, but produces less refractory period prolongation. Therefore, it is effective in treating paroxysmal supraventricular tachycardia and atrial fibrillation or flutter, but may be safer than verapamil in patients receiving digoxin or those with atrioventricular nodal disease. However, diltiazem has a greater inhibitory effect on the sinoatrial node and is more dangerous in patients who have sick sinus syndrome. Diltiazem is indicated for the treatment of cases of both types of angina, producing more vasodilation than verapamil but less than nifedipine. In addition, diltiazem has less negative inotropic activity than verapamil. Although possessing some theoretic advantages, diltiazem has not proved clinically superior to the other calcium channel blockers in the emergency setting. Therefore, it has no specific indication in emergency medicine at the present time. Except for its use in treating congestive heart failure, it has the same contraindications as verapamil.

None of the calcium channel blockers currently available are effective in cerebral salvage after cardiac arrest. However, newer calcium channel blockers, such as lidoflazine and flunarizine hydrochloride, have prevented neurologic deterioration after brief periods of global ischemia in laboratory animals. Studies are currently in progress evaluating their effects in humans.

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New Diagnostic Tests of Blunt Cardiac Trauma

MYOCARDIAL CONTUSION is an elusive clinical disorder. The absence of both a simple, accurate screening test and a diagnostic gold standard causes confusion. Moreover, no good clinical studies accurately define short- and long-term morbidity and mortality.

The workup of patients in an emergency department who have possible cardiac contusion includes a history, a physical examination and electrocardiography. The reported sensitivity and specificity for electrocardiographic prediction of cardiac contusion are variable and depend on the diagnostic criteria used. If the mechanism of injury is of high risk for cardiac contusion, the patient is admitted and CPK-MB isoenzyme studies are done. The presence of CPK-MB isoenzyme was initially thought to represent the gold standard for diagnosing cardiac contusion; recent reports, however, have shown a lack of specificity in patients with multiple trauma, even when CPK-MB ratios are used. Nevertheless, it does appear to be the most sensitive of currently used screening tests, and a clinical suggestion of cardiac contusion warrants that both an electrocardiogram (ECG) and CPK-MB values be obtained.

Radionuclide scans with technetium Tc 99m pyrophosphate have a low sensitivity for cardiac contusion and should no longer be used.

Recently, two relatively new diagnostic methods have shown promise: multiple-gated acquisition (MUGA) radionuclide scans and two-dimensional echocardiography. The MUGA scan is useful in determining whether continuing hemodynamic instability may be due to cardiac contusion.

Most patients suspected of having a cardiac contusion are young and otherwise healthy. Consequently, segmental wall dysfunction on MUGA scan is felt to be specific for cardiac contusion in young, previously healthy trauma victims.

Advantages of the multiple-gated acquisition scan include

- Cardiac dysfunction caused by cardiac contusion can be documented and a patient appropriately managed;
- Serial MUGA scans document the course of hemodynamic compromise. In one large series 27 of 32 patients with abnormalities on a MUGA scan subsequently had improvement or resolution of their wall motion defect on follow-up scans, indicating recovery of the contused myocardium;
- The test is relatively noninvasive and can be done with a portable γ-camera in an intensive care unit.

Disadvantages of the MUGA scan include the following: